Literature.

New Experiments on Building Materials, in Reference to their Conducting Power, Dryness, and Resistance to the Progress of Fire; as read before the Chemical Society of London. By JOHN HUTCHINSON, M.R.C.S. F.S.S. London: Taylor and Walton, Upper Gower-street, 1843. 8vo. p.p. 48. 1 lithograph.

THE author of this tract sets out with declaring that "having been, for some time past, engaged in the study of Medical Police, or Public Hygiène, I found upon following out one of the branches of that science (the section of warming) a great want of information respecting the relative conducting power of the various materials used in building. I therefore conceived it absolutely necessary to examine this subject, as it appeared to me impossible, or at least unwise, to put forth rules to the public for the best mode of warming buildings, with a view both to economy and safety, until I ascertained the natural relative power of the different substances used in their construction for confining heat or permitting its escape. Hence I instituted an extensive series of experiments for that object, which I now venture to lay before this society, with a few remarks relating thereto.

"To be brief, I may therefore say that the present memoir is an inquiry into the relative power of conducting caloric, of all or most of those materials used in the construction of our habitations, whether private or public, together with their relative specific heat.

"The substances which I have examined are the following, viz:—

"Of WOODS.—Oak, beech, and fir.

"Of BRICKS.—Common or Cawley stock brick, facing or malm brick, and fire brick.

"Of COMPOSITIONS.—Asphalt, hair and lime, lath and plaster, Roman cement, plaster and sand, plaster of Paris, and Keene's cement.

"Of ROCKS.—Slate, Yorkshire flag stone, Leanelle marble, Napoleon marble, Portland stone, Bath stone, chalk, and three specimens of the stones used in building the new Houses of Parliament, namely, Norfal, Bolsover, and Painswick.

"Of METALS.—Lead.

"The annexed table No. II.* will shew the times of the passage of caloric as to velocity through the various substances. It is here designated the 'resistance to the passage of heat inwards,' in contradistinction to another class of experiments, of heat passing outwards, established by the laws of cooling. In the last column of Table II., the mean time of every 10 degrees rise, is calculated. It will be here observed, that the resistance afforded to the passage of heat for the first degree, i. e. from 55 to 56°, is 7'·5, and the first ten degrees progressively less; it is not until the 100° that the time materially increases, and from thence it continues to increase up to 200°.

"ON THE RELATIVE DRYNESS OF BUILDING MATERIALS.

"This portion of the present memoir has been added after the foregoing experiments were read before the Chemical Society. Finding the subject of the natural absorbing power of these substances for water easily obtained, and believing also the inquiry to be of no less importance as regards Hygiène than that of their conducting power for heat, is the reason I assign for subjoining this matter, as it may thereby enable builders to correct, in a great measure, the evil attending that dampness natural in certain localities, which affects the foundations of buildings, to the great inconvenience of their proprietors.

"Eight other substances have also been added to twenty-two of the materials before examined. I am indebted to the kindness of my friend, Mr. Robert Robinson, of Newcastle-upon-Tyne, for forwarding to me some different specimens of flag stone now much used in that town, which has been so remarkably altered of late years; some of them will be seen by the table to resist the passing of moisture most completely; also a specimen of Maulmien teak, a wood which is now rapidly coming into use from the many advantages it possesses over oak, especially that of its not destroying iron. A specimen has also been forwarded to me of Messrs. Mann & Co.'s 'Patent stucco paint cement,' which, I understand, is extensively employed by engineers and conductors of public works, from its property of resisting the transmission of moisture in exposed and damp situations. It also adheres and with great firmness to any smooth surface, and hence is well adapted to encase brick houses. I am told the principal ingredients used in its composition are linseed oil, resin, and a sand stone, of the oolite kind, from Rouen.

"Five hundred grains of each of these materials were reduced to coarse fragments of uniform size, and laid between thick cloths, perfectly saturated with water, for a given number of hours, and afterwards weighed; the increase of their weight signifying the quantity of water absorbed by each substance. In the following table the substances are ranged in gradation; the dryest, or that which absorbs least water, placed first, and that which absorbs most water at the bottom of the list, with the others arranged between in their respective order. The first column gives the absorption by equal weights, and the second column the absorption by equal bulks; and the third column the specific gravity, or their relative weight as compared with water.

TABLE X.

Absorption of Moisture, by Weight.

Name of Substance.	Absorption of moisture by weight.	Absorption of moisture by bulk.	Specific gravity.
Aberdeen Granite ..	2·00	5·416	2·708
Napoleon Marble ..	3·00	9·85	3·284
Carrara White do...	3·10	8·42	2·717
Shetland Flag Stone	3·25	8·74	2·691
Caithness ditto	3·27	8·62	2·638
Slate	3·50	9·758	2·788
Leonelle Marble ..	4·00	10·71	2·678
Asphalt	5·00	12·86	2·572
Carrara hard Marble	8·58	23·09	2·717
Mann & Co.'s Stucco	16·00	35·56	2·223
Arbroth Flag Stone	20·50	56·77	2·477
Hewitthurn ditto ..	23·00	58·85	2·472
Fire Brick	32·00	70·43	2·201
Norfal.....	33·50	74·33	2·219
Portland.....	34·25	73·87	2·157
Yorkshire Flag	40·00	94·40	2·360
Bolsover.....	40·10	86·77	2·164
Painswick	58·00	129·80	2·238
Bath Stone.....	78·00	144·12	1·858
Maulmien Teak	82·50	61·85	·7498
Stock Brick	109·00	199·57	1·831
Hair and Lime	109·12	184·52	1·691
Malm Brick	116·50	186·63	1·602
Keene's Cement.....	126·50	155·59	1·230
Chalk	133·50	206·79	1·549
Roman Cement	133·56	208·35	1·560
Plaster and Sand ..	147·00	192·27	1·308
Beech Wood	185·50	138·04	·7442
Plaster of Paris	187·50	220·50	1·176
Oak	224·75	128·04	·5697
Fir Wood	622·75	265·41	·4262

"PRACTICAL DEDUCTIONS.

"Asphalt stands as the best composition for resisting moisture; it is a slow conductor of heat, and hence is well adapted for flooring, as in cells of prisons, where economy of heat and dryness, the most important advantages, are obtained. Slate will be seen to stand as a very dry substance, but from its quick conducting power (Table IX.)* is very unfavourable to flooring where warmth is required; but when the one property is sought for and not the other, as preventing the ascent of moisture up the walls of houses, it is well calculated to be useful, by forming a layer in the wall a few inches above the ground. The absorbing power of common brick appears very great, being more than ¼ of its own weight; whereas Mann & Co.'s cement is not greater than ⅛ of its own weight, and hence more than six times better adapted to resist moisture than brick; therefore the advantage to be derived by covering brick houses in exposed situations with this substance is considerable, while Roman cement resists moisture even worse than brick. I wish it to be borne in mind that I only speak of this stucco as regards its power of resisting the transmission of water, being the only property of it which I have examined.

"Keene's cement and plaster of Paris stand as the warmest substances, therefore are well adapted to line rooms with; while hair and lime is a remarkably quick conductor, and therefore a cold substance for that purpose. I would also draw attention to the fact that plaster and sand and plaster of Paris (particularly the latter) are admirably calculated to resist the action of fire; while we know, on the other hand, that lath and plaster is about the most combustible material in a house. I can most confidently recommend plaster of Paris and plaster and sand to be employed in surrounding iron chests, or other places which contain valuable property, intended to be protected from fire. If an iron chest be surrounded with six or eight inches in thickness of this substance, I believe it will perfectly preserve papers, &c., from any destroying heat in the midst of the burning of our ordinary dwelling-houses. I may also point out that Yorkshire flag stone is a very quick conductor, and therefore ill adapted for warm flooring; also that lead which forms the covering of roofs is a remarkably quick conductor, and therefore a great waste of heat is experienced where such covering exists; hence the third back rooms on ground floors in our London houses are found to be so cold; a vast quantity of heat escapes through the leaden roof and through three of the surrounding walls, which are generally external, and so this as to allow of a free escape of heat. Such places should be lined with slow conductors if warmth is sought for. Touching the practical utility of the specific heat experiments, I may point out that fire-brick absorbs a great quantity of heat, and therefore is well adapted to form the backs of our fire-grates; whereas, with iron backs, there is an enormous waste of fuel and heat, at the same time the fire requires constant stirring, and a quick supply of coal to keep it in; yet, curious to remark, we never enter a house, even of the highest order, where iron backs to fire-grates are not universally to be seen; while a back formed of a composition, as that of fire-brick, which can be as easily moulded into any desirable shape, would save fuel, thoroughly warm any apartment, require less stirring, and not go out so soon.

"There certainly exists in the present day a most extraordinary inattention to the economising of artificial heat generated in the fire-grates of our dwellings in this country; the whole of this error proceeds from the total inattention of architects and builders to the subject of the difference of conduction of heat by different materials, which, I consider, is one of the most important points to study before an architect attempts to construct a dwelling. According to Depréts, iron is more than twice as quick a conductor as lead, and, according to these experiments, lead is more than eight times as quick a conductor as fire-brick, bearing the relation of 1888 to 223; and the difference of the relative absorbing power for heat, viz., that heat which is required to bring them to the same temperature, is in the relation of ·0392 to ·1917, the fire-brick retaining nearly seven times more heat than the lead. If to this we add the great escape of heat by the chimney, well might it be said that 'not more than a fiftieth portion of the heat generated was rendered available for warming apartments at the period Franklin visited England.' Rumford estimated the loss of heat and fuel to be more than ¾, and the lowest estimate is that of ½. A due consideration of conduction, in relation to this most necessary part of our habitations, would, in a great measure, contribute to produce that which is sought for by every Englishman, 'a cheerful fireside.'

"With regard to the specimens of wood I have examined, it is worth observing that Maulmien teak absorbs much less water than oak wood, in the proportion of 82 to 224, being nearly one-third less; (?) and as the density of woods in their ordinary state bears a strict relation to their porosity or proportion of air within their pores, connecting with this, the fact that iron, protected from contact with the atmosphere and water (being compounds of oxygen), the better it is preserved, may very possibly be the reason assignable for the truth why iron is preserved considerably longer in Maulmien teak than in oak; the relation of absorption of water with the teak and oak (omitting the decimals) is as 82 of the former to 224 of the latter. The density of all these specimens of wood is here calculated from the state in which they naturally exist, that is, as dry as could be obtained, yet containing an unknown quantity of air and moisture. Mr. Parnell observes, 'when wood, rendered perfectly dry by the aid of heat, is exposed at

* We have not space for the insertion of these valuable tables.